

AMENDMENTS TO THE CLAIMS

Following is a listing of all claims in the present application, which listing supersedes all previously presented claims:

Listing of Claims:

1. (Currently Amended) A printed circuit board including a dielectric substrate and integrated with a two-axis fluxgate sensor, comprising:

a first rectangular ring type soft magnetic core arranged lengthwise along a first axial direction;

a first excitation coil portion winding around the first soft magnetic core;

a first pick-up coil portion winding around the first soft magnetic core;

a second rectangular ring type soft magnetic core arranged lengthwise along a second axial direction, the second axial direction being perpendicular to the first axial direction;

a second excitation coil portion winding around the second soft magnetic core; and

a second pick-up coil portion winding around the second soft magnetic core;

wherein the first soft magnetic core is disposed on a first side of the dielectric substrate and the second soft magnetic core is disposed on a second side of the dielectric substrate, and

wherein the first excitation coil portion is electrically connected to the second excitation coil portion by a first via and the first pick-up coil portion is electrically connected to the second pick-up coil portion by a second via.

2.-16. (Cancelled)

17. (Previously Presented) The printed circuit board as claimed in claim 1, wherein each of the first and second soft magnetic cores comprises a first parallel pair of bar-type portions extending along the first axial direction and a second parallel pair of bar-type portions extending along the second axial direction and the first and second soft magnetic cores extend along a plane that is substantially parallel to the dielectric substrate, wherein each of the first and second soft magnetic cores serves as a closed magnetic path.

18. (Previously Presented) The printed circuit board as claimed in claim 17, wherein the first excitation coil portion separately winds around each bar-type portion of the first parallel pair of bar-type portions of the first soft magnetic core in a solenoid pattern extending along the first axial direction and the second excitation coil portion separately winds around each bar-type portion of the second parallel pair of bar-type portions of the second soft magnetic core in a solenoid pattern extending along the second axial direction.

19. (Previously Presented) The printed circuit board as claimed in claim 18, wherein:
the first pick-up coil portion winds around both bar-type portions of the first parallel pair of bar-type portions of the first soft magnetic core together in a solenoid pattern extending along the first axial direction, and

the second pick-up coil portion winds around both bar-type portions of the second parallel pair of bar-type portions of the second magnetic core together in a solenoid pattern extending along the second axial direction.

20. (Currently Amended) The printed circuit board as claimed in claim 17, wherein:

along a plane substantially perpendicular to the dielectric substrate and the first axial direction, the first excitation coil portion winds around one of the bar-type portions of the first parallel pair of bar type portions of the first soft magnetic core and the first pick-up coil portion winds around the other of the bar-type portions of the first parallel portions of the first soft magnetic core, and

along a plane substantially perpendicular to the dielectric substrate and the first axial direction, the second excitation coil portion winds around one of the bar-type portions of the ~~second~~first parallel pair of bar-type portions of the second soft magnetic core and the second pick-up coil portion winds around the other of the bar-type portions of the ~~second~~first parallel pair of bar-type portions of the second soft magnetic core.

21. (Currently Amended) The printed circuit board as claimed in claim 17, including a plurality of the first vias and a plurality of the second vias, wherein:

each of the first excitation coil portion and the first pick-up coil portion includes a plurality of first upper portions on the first side of the dielectric substrate and a plurality of corresponding first lower portions on the first side of the dielectric substrate, the first upper portions being further from the first side of the dielectric substrate than the corresponding first lower portions,

each of the second excitation coil portion and the second pick-up coil portion includes a plurality of second upper portions on the second side of the dielectric substrate and a plurality of corresponding second lower portions on the second side of the dielectric substrate, the second upper portions being arranged further from the second side of the dielectric substrate than the corresponding second lower portions,

the plurality of first upper portions of the first pick-up coil portion and the plurality of first upper portions of the first excitation coil portion corresponding to a patterned first upper conductive film,

the plurality of corresponding first lower portions of the first pick-up coil portion and the plurality of first lower portions of the first lower portions of the first excitation coil corresponding to a patterned first lower conductive film,

the plurality of first upper portions of the first pick-up coil portion being electrically connected with the plurality of corresponding first lower portions of the first pick-up coil portion by way of respective ones of the second vias, and

the plurality of first upper portions of the first excitation coil portion being electrically connected with the plurality of corresponding first lower portions of the first excitation coil portion by way of respective ones of the first vias.

22. (Currently Amended) The printed circuit board as claimed in claim 21, wherein:
each of the first upper portions of the first excitation coil portion substantially faces the first corresponding lower portion of the first excitation coil portion with at least one of the bar-type portions of the first pair of parallel bar-type portions of the first soft magnetic core extending between and overlapping the first upper portion and the corresponding first lower portion of the first excitation coil portion, and

each of the second upper portions of the second excitation coil portion substantially faces the second corresponding lower portion of the second excitation coil portion with at least one of the bar-type portions of the ~~first~~second pair of parallel bar-type portions of the second soft

magnetic core extending between and overlapping the second upper portion and the corresponding second lower portion of the second excitation coil portion.

23. (Currently Amended) The printed circuit board as claimed in claim 22, wherein:
each of the first upper portions of the first pick-up coil portion substantially faces the first corresponding lower portion of the first pick-up coil portion with at least one of the bar-type portions of the first pair of parallel bar-type portions of the first soft magnetic core extending between and overlapping the first upper portion and the corresponding first lower portion of the first pick-up coil portion, and

each of the second upper portions of the second pick-up coil portion substantially faces the second corresponding lower portion of the second pick-up coil portion with at least one of the bar-type portions of the ~~first~~second pair of parallel bar-type portions of the second soft magnetic core extending between and overlapping the second upper portion and the corresponding second lower portion of the second pick-up coil portion.

24. (Currently Amended) The printed circuit board as claimed in claim 21, wherein:
each of the first upper portions of the first excitation coil portion substantially faces the first corresponding lower portion of the first pick-up coil portion with at least one of the bar-type portions of the first pair of parallel bar-type portions of the first soft magnetic core extending between the first upper portion of the first excitation coil and the corresponding first lower portion of the first pick-up coil portion, and

each of the second upper portions of the second excitation coil portion substantially faces the second corresponding lower portion of the second pick-up coil portion with at least one of the

bar-type portions of the ~~first~~second pair of parallel bar-type portions of the second soft magnetic core extending between and overlapping the second upper portion of the second excitation coil portion and the corresponding second lower portion of the second pick-up coil portion.

25. (Currently Amended) The printed circuit board as claimed in claim 24, wherein:
each of the first upper portions of the first pick-up coil portion substantially faces the first corresponding lower portion of the first excitation coil portion with at least one of the bar-type portions of the first pair of parallel bar-type portions of the first soft magnetic core extending between and overlapping the first upper portion of the first pick-up coil portion and the corresponding first lower portion of the first excitation coil portion, and

each of the second upper portions of the second pick-up coil portion substantially faces the second corresponding lower portion of the second excitation coil portion with at least one of the bar-type portions of the ~~first~~second pair of parallel bar-type portions of the second soft magnetic core extending between and overlapping the second upper portion of the second pick-up coil portion and the corresponding second lower portion of the second excitation coil portion.

26. (Previously Presented) The printed circuit board as claimed in claim 17, wherein:
the first excitation coil portion alternately winds around each bar-type portion of the first parallel pair of bar-type portions of the first soft magnetic core in a figure-eight pattern extending along the first axial direction, and

the second excitation coil portion alternately winds around each bar-type portion of the second parallel pair of bar-type portions of the second soft magnetic core in a figure eight pattern extending along the second axial direction.

27. (Previously Presented) The printed circuit board as claimed in claim 26, wherein:
the first pick-up coil portion winds around both bar-type portions of the first parallel pair of bar-type portions of the first soft magnetic core together in a solenoid pattern extending along the first axial direction, and

the second pick-up coil portion winds around both bar-type portions of the second parallel pair of bar-type portions of the second magnetic core together in a solenoid pattern extending along the second axial direction.

28. (Previously Presented) The printed circuit board as claimed in claim 26, wherein:
the first pick-up coil portion winds around both bar-type portions of the first parallel pair of bar-type portions of the first soft magnetic core together in a solenoid pattern extending along the first axial direction,

the second pick-up coil portion winds around both bar-type portions of the second parallel pair of bar-type portions of the second soft magnetic core together in a solenoid pattern extending along the second axial direction,

the winding of the first pick-up coil portion is off-set from the winding of the first excitation coil portion, and

the winding of the second pick-up coil portion is off-set from the winding of the second excitation coil portion.

29. (Previously Presented) The printed circuit board as claimed in claim 26, wherein:

the first pick-up coil portion separately winds around each bar-type portion of the first parallel pair of bar-type portions of the first soft magnetic core in a solenoid pattern extending along the first axial direction and the second pick-up coil portion separately winds around each bar-type portion of the second parallel pair of bar-type portions of the second soft magnetic core in a solenoid pattern extending along the second axial direction.

the winding of the first pick-up coil portion is off-set from the winding of the first excitation coil portion, and

the winding of the second pick-up coil portion is off-set from the winding of the second excitation coil portion.

30. – 64. (Cancelled)

65. (New) The printed circuit board as claimed in claim 1, wherein the first side of the dielectric substrate is opposite to the second side of the dielectric substrate.

66. (New) The printed circuit board as claimed in claim 1, wherein at least a portion of the dielectric substrate is sandwiched between the first pick-up coil portion and the second pick-up coil portion.

67. (New) The printed circuit board as claimed in claim 1, wherein at least a portion of the dielectric substrate is sandwiched between the first excitation coil portion and the second excitation coil portion.